MEDICAL CARE QUALITY EVALUATION USING THE FLEET MARINE FORCE MEDICAL INFORMATION SYSTEM

F. C. GARLAND

REPORT NO. 83-33

NAVAL HEALTH RESEARCH
SAN DIEGO, CA

NAVAL MEDICAL RESEARCH AND DEVELOPMENT
BETHESDA, MA

MEDICAL CARE QUALITY EVALUATION USING THE FLEET MARINE FORCE MEDICAL INFORMATION SYSTEM

Frank C. Garland
Environmental Medicine Department
Naval Health Research Center, San Diego

Naval Health Research Center
P. O. Box 85122
San Diego, California 92138-9174

Report No. 83-33 was supported by Naval Medical Research and Development Command, Bethesda, Maryland, Department of the Navy, under research Work Unit M0095-PN.001-1047. The views presented in the paper are those of the author. No endorsement by the Department of the Navy has been given or should be inferred.

SUMMARY

The Fleet Marine Force medical information system should include provisions for evaluation of the medical care provided at all echelon levels. The care provided in the immediate period after an injury can determine likelihood of survival or extent of disability. Recent advances in trauma scores that could be applied in the field can greatly enhance capabilities for evaluation studies, epidemiologic research, and disease surveillance.

INTRODUCTION

Insuring a uniform high standard of casualty care in the U.S. Navy requires a system for evaluating the efficacy of the casualty care delivered (1,2). The Fleet Marine Force medical information system should include provisions for evaluation of all aspects of the system. There should be an ability to evaluate mortality, morbidity, and residual disability while standardizing for severity of injury. The capability for evaluation should begin at the first echelon of medical care, when the hospital corpsman makes the first contact with an injured patient. It should be continued through all levels of care, since continued measurement of the patient's physiological status at all levels of care is essential to evaluation of the success of casualty care delivery.

The immediate period following injury can determine likelihood of survival (3,4). The efficacy of pre-hospital treatment modalities such as use of military antishock trousers and early fluid replacement can only be evaluated if assessment of severity is made at the scene of injury. Evaluation of the impact of intervening factors affecting patient outcome, such as delays in transportation, also require early determination of severity. Innovations in automated medical record keeping for the Fleet Marine Force can greatly enhance capabilities for such evaluation studies.

DATA RESOURCES

Recent advances in information storage capacity have made possible a microchip in a dogtag that will contain 64,000 bits of information (5). The chip is reported to be able to survive extremes of temperature, shock, and to some degree, electromagnetic fields. This advance in technology will benefit the quality and efficiency of clinical care and epidemiologic research in the Navy, other services, and, eventually, the civilian population.

The microchip dogtag can contain identifying data, the person's blood type history of allergies, general medical history, and medications currently prescribed. Its large capacity for information could also permit it to be used to store data captured during initial diagnosis and treatment of acute trauma or illness, providing an important information resource for clinical management and research. Since the data would be stored in a machine-readable format, the efficiency of epidemiologic studies would be high. Such studies could include investigations of the relative benefits of different approaches to trauma care such as types and quantities of intravenous fluids used to treat shock, benefits of more definitive care at the scene of the trauma, and effects of rapid versus delayed treatment on survival and disability.

The medical information stored in the chip could be routinely electronically transferred to Department of Defense medical information systems, becoming part of the person's lifetime medical record.

Needs for medical information vary according to the demand placed on the system of medical care and the ability of the system to collect, store, and act on information. When there are relatively few cases of acute trauma or illness in any facility, time and resources may exist to collect much information that will be useful for research and highly refined clinical management.

During crises, the number of casualties can become so large that only the most rudimentary

collection of medical information is possible. Any system designed for military applications should include the ability to modify the system's information input requirements according to the conditions facing the providers of care. Output formats should be similarly flexible, so that detailed clinical information would be displayed when circumstances allow, but only critically important information would be displayed during crises.

It is likely that solely computer-based medical information systems will have their maximum value during peacetime, providing a means for access to the medical history during emergency treatment of acute illness and trauma from accidents or occasional minor conflicts.

A system that relies heavily on computers may not be as useful under battlefield conditions, when treatment is less individualized and information requirements necessarily less comprehensive, and it is not likely that any system would be of value in the catastrophic setting of a nuclear conflict.

One benefit of the microchip dogtag is the information it could provide about the patient at early echelon care facilities. An example of electronically stored data entered at the battalion level is shown in Figure 1. Blood type allows for expeditious ordering of replacement blood, and allergy history information prevents use of medicines that may induce harmful reactions (6,7). Medical history data allow an understanding of pre-existing conditions and treatments that may affect present and future treatment choices, but which cannot be elicited from an unconscious patient. The history may alert the provider of care to conditions, such as peptic ulcer disease, which could explain the acute appearance of symptoms of hemorrhagic shock. When so alerted, the provider's care is likely to be more refined and specific to the problem. The time needed to reach a diagnosis also can be reduced by having appropriate historical information available.

A listing of present medications could help explain the appearance of acute signs or symptoms which are side-effects of medications, and help the provider assess paradoxical test results which can sometimes result from medication.

Stored clinical parameters can provide baseline values for comparison with parameters at the time of treatment, and stored data on risk factors can provide a basis for judging the likelihood of pulmonary, hepatic, or other diseases. Less-detailed medical information, such as blood type and drug allergies, could be visually readable on the surface of the dogtag in addition to being electronically stored in the chip.

This information would be of maximum value at the battalion aid station, hospital, or higher level of care. At the scene, it could be useful for transmission of advance data to the battalion aid station, or higher levels of care regarding blood needs by type, and other logistic needs. At the second echelon, the microchip information could help with medication decisions.

Beginning possibly at the scene of the accident or illness, post-event information could be added to the microchip dogtag concerning data captured after the event, or this could be done using paper and pencil forms. These data would include intravenous fluids and medications administered, tourniquets applied, and vital signs (including blood pressure, pulse, respiration and temperature) taken every 15 minutes (or more frequently in critical cases) trauma scores, coma indices, and other information.

The post-event information could be recorded on a machine-readable field medical card, or ideally on a portable data entry device carried in the field, and at the battalion aid station. The data which would be obtained before transport to the second echelon of care are listed in Table 1. These data include critical time parameters, a severity-of-injury index, and a record of treatments administered.

A measure of severity is essential for research into the effects of treatment (1,2,8). This measure should be obtained at the scene of injury or illness, before treatment is administered (8). A measure of severity, the Trauma Score designed by Champion and Sacco, is also shown in Table 1 (2,4,10,11). Severity data would provide a means for comparing the effects of various treatments and different medical care facilities on patients with trauma of similar severity. The Trauma Score would also be useful for triage, clinical decisions, allocation of intensive care unit beds, and evaluation of emergency systems and trauma care (2).

The development of the Trauma Score has provided a means for comparing the outcome of injured patients treated with different modalities. It has been applied to a large number of patients and has been shown to be a reliable predictor of patient outcome (4). Sacco, et al., conducted a study to determine the accuracy with which Navy Hospital corpsmen could obtain a Trauma Score on trauma patients in surgical intensive care units and concluded that corpsmen were capable of performing the clinical assessments required by the Trauma Score, with minimal training and very little experience, in a well-controlled clinical environment (9). A combat situation presents a more difficult environment but does not preclude using a rapidly performed trauma assessment score.

In a civilian setting, Baxt and Moody used the Trauma Score to compare the case fatality rate of 150 consecutive blunt trauma patients treated by land emergency medical systems and taken to a trauma center with that of 150 consecutive blunt-trauma patients treated by a helicopter aeromedical emergency care system staffed by a physician and a nurse and transported by air to the same center (10). Trauma Scores were assigned on initial physician contact, at the trauma resuscitation area of the hospital for land patients, and on the injury site by a physician for patients transported by helicopter. Trauma Scores allowed calculation of projected number of deaths based on injury severity. This was compared with the observed number of deaths in the two treatment groups. In the patients transported by land ambulance, 15 deaths were projected, while 19 patients were observed. For the patients transported by helicopter, 21 deaths were projected but only 10 were observed. This represents a 52% reduction from the projected mortality. The Trauma Score allowed for an assessment of the distribution of the severity of injury in the two treatment groups, and made possible comparisons taking this factor into account.

EPIDEMIOLOGIC APPLICATIONS

Measurement of the success of treatment is essential to the improvement of the quality of medical care. Success varies, however, according to variables other than the quality of care, such as severity of injury or illness; delays in transportation; and age and medical history of the patient. Comparisons of different treatments are not meaningful unless these other variables are measured and taken into account.

Use of Trauma Scores assigned early in casualty care will permit the comparison, for example, of effects of different kinds of intravenous fluids or medications on survival and disability, ultimately permitting many evaluation studies that could lead to improvements in the quality of care.

When doubts exist about the relative value of new medications or treatment strategies, it may be possible to assign some units at random to trial use of the new drug or method while others use the existing medicine or technique. Outcomes can then be compared while controlling for severity and patient characteristics. The relative benefit of the new approach and any hazards associated with it can be measured with a high degree of precision when these factors are controlled. Examples of this type of study might include trails of hyperosmolar saline solutions versus lactated Ringer's solution in burn victims or of various alternative medications or procedures designed to combat shock. Measurements could also be performed on the efficacy of more definitive procedures, such as surgery.

The proposed use of a trauma score in the field would allow monitoring for excessive mortaltiy or extended disability in patients with a particular class of trauma or illness, in order to promptly assess the benefits of various procedures in the field or in hospitals. The occurrence of an unusually high incidence rate of postoperative pneumonia in patients who received a particular anesthetic agent administered only in certain surgical units, for example, could be rapidly detected using the proposed system. The rapidity of detection of such a problem would result from the immediate entry of dogtag data, patients' physiological parameters, and treatment data to a medical information system as treatment is administered.

Clinical data collected in the field would be stored temporarily in the dogtag microchip at the scene of injury or illness and at the second echelon of care. The data would be transferred to a stand-alone computer at the hospital or third echelon of care and used for clinical management and monitoring of the quality of care at the scene of the event, during transport to the second echelon, at the second echelon, and during transport from the second echelon to the hospital. The information would be periodically transferred to a central medical records computer facility in the continental United States, where it would be available for logistics, planning, and research uses.

Other epidemiological applications of the proposed system could include studies of the effects on survival and residual disability of training of field corpsmen or studies of type and severity of casualties according to type of combat operation. Such studies could use linked information from sources other than the medical record, such as unit diaries and reports.

As the Navy and other services work to retain well-trained but older personnel, the prevalence of chronic conditions such as hypertension will increase. This will lead, in combination with other factors, to an increased incidence of cardiovascular disease. The proposed system is equally well-suited to evaluating the effects of prompt and definitive care for myocardial infarctions and other acute manifestations of cardiovascular disease, since survival rates can be studied according to medications, intravenous fluids, and resuscitation procedures administered. Similar benefits could occur for other diseases, including disorders of the

digestive, pulmonary, and nervous systems.

Rapid and accurate data entry of the type made possible by a computerized information system would allow for rapid epidemiologic surveillance of infectious and environmentally-induced diseases throughout the Navy and in other services which adopt it. Since geographic location of the event could be included in the record data entered in the dogtag microchip during treatment, automated mapping of disease and injury occurrences and rates by military unit could be rapidly performed.

This could provide a fully automated system for surveillance of infectious diseases endemic in certain parts of the world (e.g., malaria, typhoid fever, yellow fever, influenza). Rapid identification of these disease sources could result in the prompt implementation of preventive measures, such as temporary restriction of shore leave in extremely high-risk ports, limited quarantine, insecticide spraying, or other techniques which could reduce the number of personnel affected by infectious diseases. If use of chemical or biological agents was suspected, the field medical information system could provide for rapid analysis to determine if these agents were in use. If use was established, the system could rapidly pinpoint the geographic locations where the casualties were occurring.

For the system to be useful for epidemiological studies, dogtag information must be entered for all injured and acutely ill persons, including those who do not survive until arrival at the second echelon of care. Currently, many fatalities which occur before arrival at the second echelon are not recorded by the medical records system, but valid evaluation of the quality of care provided at the scene of injury or acute illness depends on inclusion of these prompt fatalities.

Another requirement for epidemiologic studies is recording of whether any particular episode of a disease is the first episode of that disease for the patient. This is handled by asking each patient whether he or she has had the illness in the past, and entering the answer. This question would make possible the calculation of incidence rates based on <u>new</u> cases of most diseases of epidemiologic interest, rather than recurrence of reactivation of existing diseases. In some instances, however, recurrence or reactivation may be of particular interest, such as in studies of sexually transmitted diseases, malaria, and tuberculosis. Inclusion of a question on previous illness would help to identify such recurrences.

Accuracy of data is critical to epidemiologic studies, and is best assured by accuracy of data entry and continuous monitoring of data transfer. Accuracy of data entry can be enhanced by carefully planned and executed training programs for field corpsmen and other users of the system, regular retraining, and the incorporation of editing routines which operate during data entry to alert the person entering the data to errors of data entry and request verification of unusual or unexpected data values.

PERFORMANCE SPECIFICATIONS FOR EQUIPMENT AND SOFTWARE

Committees which have examined the problem of a field medical information system have suggested that several different types of equipment may be needed (11). If care at the scene of injury or acute illness and entry of trauma scores is to be computerized, an extremely lightweight

simple-to-operate unit with a small but visible screen is needed. The unit should be able to read the information on the microchip dogtag, display it in an easily readable format, permit easy da entry, store data for multiple patients, and have a capability for transmitting this information to the second echelon of care. In a combat situation, machine-readable paper and pencil forms may be necesary in the field.

Peacetime transmission of data to the central computer facility could be carried out over satellite or land-based microwave circuits during times of low circuit usage. Error detection and correction techniques should be implemented to assess the degree of introduction of errors during long-distance transmission and to provide for automatic correction of these errors. All data stored in the central computer facility would need to be thoroughly backed up, with creation of backup tapes incorporating new data every 8-12 hours. The central computer facility should be duplicated in two or more locations to enhance survivability in natural or man-made disasters.

CONCLUSION

The Fleet Marine Force medical information system should include provisions for evaluation of the medical care provided at all echelons. The care provided in the immediate period after an injury can determine likelihood of survival or or extent of disability. The efficacy of immediate treatment modalities can only be evaluated if an assessment of severity is made at the scene of injury or illness. Recent advances in development of trauma scores and innovations in automated record keeping could greatly enhance capabilities for evaluation studies, epidemiological research, and disease.

REFERENCES

1. Baker SP, O'Neill B, Haddon W, et al. The injury severity score: A method for describing patients with multiple injuries and evaluating emergency care. J Trauma 1974;14:187.
2. Cahmpion HR, Sacco WJ, Hannon DS, et al. Assessment of injury severity: The Triage index. Crit. Care Med 1980, 8:201.
3. Jorden RC. Multiple trauma. In: Rosen P, Baker II FJ, Braen GR, Dailey RH, Levy RC, eds. Emergency medicine: concepts and clinical practice. St. Louis, Toronto, London: C. V. Mosby, 1983: 26-53.
4. Champion HR, Sacco WJ, Carnazzo AJ, Copes W, Fouty WJ. Trauma score. Crit Care Med 1981; 9:672-676.
5. Datakey, Inc. Preliminary data sheet, Model DT64K. 12281 Nicollet Avenue, Burnsville, Minnesota, 1983.
6. Storer DL. Blood and blood component therapy. In: Rosen P, Baker II FJ, Braen GR, Dailey RH, Levy RC, eds. Emergency medicine: concepts and clinical practice. St. Louis, Toronto, London: C. V. Mosby, 1983:151-165.
7. Parker CW. Drug Allergy. In Parker CW, ed. Clinical Immunology, II. Philadelphia, London, Totonto: WB Saunders, 1980:1219-1260.

8. Trunkey DD, Siegel J, Baker SP, Gennarelli TA, Panel: Current status of trauma severity indices. J Trauma 1983; 23:185-201.

9. Sacco WJ, Champion HR, Henderson JV, et al. Testing of Navy Corpsmen in trauma score assessment. In: Shriver B, Walker TM, Cousins R, eds. proceeding of the 16th annual Hawaii International Conference on Systems Sciences. Los Angeles, Ca: Western Periodicals, 1983:144-153.

10. Baxt WG, Moody P. The impact of a rotorcraft aeromedical emergency care service on trauma mortality. JAMA 1983;249:3047-3051.

11. Department of the Navy, Naval Medical Research and Development Command. Report of the FMF Medical Information Systems Requirements Definition Workshop, 20-21 May 1982. Bethesda, Maryland, National Naval Medical Center, 1982.

John Doe

Master Chief Petty Officer, USN

Duty Station USS Eisenhower, Bosn's Mate

Male Age 33 Roman Catholic Blood type O positive

ALLERGIES: penicillin G-6-PD deficient

MEDICAL HISTORY: Appendectomy, age 14; infectious hepatitis, age 19; malaria, age 21; positive ppd, age 25; angina pectoris, age 32; hypertension, age 32; peptic ulcer, age 32

PRESENT MEDICATIONS: Hydrochlorothiazide, 50 mg, once a day, propranolol, 60 mg, once a day; antacids, 2 tb, 3 times a day

MOST RECENT CLINICAL PARAMETERS: Blood pressure 150/90 on medication

RISK FACTORS: Cigarette smoker, 20 pack-years, maximum, 3 packs/day; alcohol use 3 beers 3 times per week since age 21

OPTHALMOLOGICAL PRESCRIPTION: Stored for access on request

ORGAN DONOR STATUS:

FIGURE 1

Table 1

Information to Be Obtained at Echelon I

Demographic

Name
Social Security Number

Time and location

Time of injury or onset of symptoms
Time first examined
Geographic location where injury occurred

Injury

Tourniquet
- Site
- Time applied
- Time released
- Reapplication times

Morphine

- Dose
- Route
- Time

Other medications

- Type
- Dose
- Route
- Time

Trauma Score (includes Glascow Coma Score)*

- Respiratory rate
- Respiratory expansion
- Systolic blood pressure
- Capillary refill
- Eye opening
- Verbal response
- Motor response

UNCLASSIFIED

SECURITY CLASSIFICATION OF THIS PAGE *(When Data Entered)*

REPORT DOCUMENTATION PAGE		READ INSTRUCTIONS BEFORE COMPLETING FORM
1. REPORT NUMBER 83-33	2. GOVT ACCESSION NO. AD-A142935	3. RECIPIENT'S CATALOG NUMBER
4. TITLE *(and Subtitle)* MEDICAL CARE QUALITY EVALUATION USING THE FLEET MARINE FORCE MEDICAL INFORMATION SYSTEM		5. TYPE OF REPORT & PERIOD COVERED Final 6. PERFORMING ORG. REPORT NUMBER
7. AUTHOR(s) Frank C. Garland		8. CONTRACT OR GRANT NUMBER(s)
9. PERFORMING ORGANIZATION NAME AND ADDRESS Naval Health Research Center P. O. Box 85122 San Diego, CA 92138		10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS MF58.524.001-0007
11. CONTROLLING OFFICE NAME AND ADDRESS Naval Medical Research & Development Command Naval Medical Command, National Capital Region Bethesda, MD 20814		12. REPORT DATE 8 Dec 1983 13. NUMBER OF PAGES
14. MONITORING AGENCY NAME & ADDRESS(if different from Controlling Office) Commander, Naval Medical Command Department of the Navy Washington, DC 20372		15. SECURITY CLASS. (of this report) UNCLASSIFIED 15a. DECLASSIFICATION/DOWNGRADING SCHEDULE

16. DISTRIBUTION STATEMENT *(of this Report)*

Approved for public release; distribution unlimited.

17. DISTRIBUTION STATEMENT *(of the abstract entered in Block 20, if different from Report)*

Approved for public release; distribution unlimited.

18. SUPPLEMENTARY NOTES

19. KEY WORDS *(Continue on reverse side if necessary and identify by block number)*

Evaluation
Trauma Score
Epidemiologic
Severity index
Medical Information Systems

20. ABSTRACT *(Continue on reverse side if necessary and identify by block number)*

The Fleet Marine Force medical information system should include provisions for evaluation of the medical care provided at all echelon levels. The care provided in the immediate period after an injury can determine likelihood of survival or extent of disability. Recent advances in trauma scores that could be applied in the field can greatly enhance capabilities for evaluation studies epidemiologic research, and disease surveillance.

DD FORM 1 JAN 73 1473 EDITION OF 1 NOV 65 IS OBSOLETE
S/N 0102-LF-014-6601

UNCLASSIFIED

SECURITY CLASSIFICATION OF THIS PAGE *(When Data Entered)*